

ANNEX I

ESSENTIAL SAFETY REQUIREMENTS

1. **Materials**

Materials shall be selected according to the intended use of the vessels and in accordance with points 1.1 to 1.4.

1.1. *Pressurised parts*

The materials used for manufacturing the pressurised parts of the vessels shall be:

- (a) capable of being welded;
- (b) ductile and tough, so that a rupture at minimum working temperature does not give rise to either fragmentation or brittle-type fracture;
- (c) not adversely affected by ageing.

For steel vessels, the materials shall in addition meet the requirements set out in point 1.1.1 and, for aluminium or aluminium alloy vessels, those set out in point 1.1.2.

They shall be accompanied by an inspection slip as defined in point (i) of point 3.1 of Annex III, drawn up by the producer of the materials.

1.1.1. *Steel vessels*

Non-alloy quality steels shall meet the following requirements:

- (a) they shall be non-effervescent and supplied after normalisation treatment, or in an equivalent state;
- (b) the content per product of carbon shall be less than 0,25 % and that of sulphur and phosphorus shall each be less than 0,05 %;
- (c) they shall have the following mechanical properties per product:
 - (i) the maximum tensile strength $R_{m,max}$ shall be less than 580 N/mm²;
 - (ii) the elongation after fracture shall be:

if test pieces are taken parallel to the direction of rolling:

thickness \geq 3 mm:	A	\geq 22 %,
thickness < 3 mm:	A _{80 mm}	\geq 17 %,

if test pieces are taken perpendicular to the direction of rolling:

thickness \geq 3 mm:	A	\geq 20 %,
thickness < 3 mm:	A _{80 mm}	\geq 15 %,

- (iii) the average bending rupture energy KCV for three longitudinal test pieces at minimum working temperature shall not be less than 35 J/cm². Not more than one of the three figures may be less than 35 J/cm², with a minimum of 25 J/cm². In the case of steels intended to be used in the manufacture of vessels

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the minimum working temperature of which is lower than $-10\text{ }^{\circ}\text{C}$ and the wall thickness of which exceeds 5 mm, this property shall be checked.

1.1.2. *Aluminium vessels*

Non-alloy aluminium shall have an aluminium content of at least 99,5 % and the alloys referred to in point (b) of Article 1(1) shall display adequate resistance to intercrystalline corrosion at maximum working temperature.

Moreover, these materials shall satisfy the following requirements:

- (a) they shall be supplied in an annealed state;
- (b) they shall have the following mechanical characteristics per product:
 - the maximum tensile strength $R_{m,max}$ shall be no more than 350 N/mm^2 ,
 - the elongation after fracture shall be:
 - $A \geq 16\%$ if the test piece is taken parallel to the direction of rolling,
 - $A \geq 14\%$ if the test piece is taken perpendicular to the direction of rolling.

1.2. *Welding materials*

The welding materials used to manufacture the welds on or of the vessel shall be appropriate to and compatible with the materials to be welded.

1.3. *Accessories contributing to the strength of the vessel*

These accessories (for example bolts and nuts) shall be made of a material specified in point 1.1 or of other kinds of steel, aluminium or an appropriate aluminium alloy compatible with materials used for the manufacture of pressurised parts.

The latter materials shall at minimum working temperature have an appropriate elongation after fracture and bending rupture energy.

1.4. *Non-pressurised parts*

All unpressurised parts of welded vessels shall be of materials which are compatible with that of the components to which they are welded.